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ARTICLE

Assessing Occupational Exposure to Surface Contaminants in Kuwaiti Educational Buildings

Abdul-Salam Al-Temeemi[1*] Jamal Al-Hubail[1] Ahmad Al-Khayat[2]

1. College of Technology, Kuwait
2. Kuwait Institute for Scientific Research, Kuwait

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ABSTRACT

The prevalence of surface contaminants, such as potentially harmful bacteria, within building environments in the State of Kuwait is not known. To the authors' knowledge, this article is the first of such a report. A total of 342 stool samples were collected from 46 secondary schools to evaluate indoor occurrences of *E. coli* bacteria within selected lavatory surfaces. After microbiological testing, the results for the spread of the *E. coli* bacteria were categorized by total count, sampling location dependency, contamination level comparison between genders, and lavatory fixtures (i.e. seat and squat toilets). The results revealed that 7 schools have a bacterial contamination problem, there is cross-contamination between surfaces in the lavatory stalls, the boys' lavatories were less sanitary than the girls', and that the squat-style toilets are more contaminated than the seat-style. The results suggest that there is significant risk of spread of bacterial infection among students via contaminated hands and surfaces in the lavatory area in some schools. Thus, this study emphasizes the need to improve environmental hygiene and enhanced sanitation in these schools. In addition, conclusions can be drawn as to the effectiveness of the janitorial staff employed by the schools and the efficacy of the cleaning regime used in the lavatories. Furthermore, based on the findings, there are architectural design consequences as squat-style toilets might be excluded in lavatories designed for schools to be constructed in the future.

1. Introduction

Little is known about the complex microbial ecosystems found in the built environment. This is especially true for the State of Kuwait where the microbiology of the built environment is a new field of scientific inquiry. With no such studies conducted in Kuwait, investigating this topic will provide an indication as to the hygienic safety in public buildings and will provide

**Corresponding Author:*
Abdul-Salam Al-Temeemi,
Faculty Member, Assistant Professor, College of Technology, Kuwait,
E-mail: temeemi@hotmail.com.
About Other Authors:
Jamal Al-Hubail,
Faculty Member, Assistant Professor, College of Technology, Kuwait,
E-mail: ja.alhubail@paaet.edu.kw;
Ahmad Al-Khayat,
Research Associate Professor, Kuwait Institute for Scientific Research, Kuwait,
E-mail: akhayat@kisr.edu.kw.

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a baseline for future investigations. With surrounding countries having similar schools, gender segregated education, culture, climate, customs, and hygienic practices, the findings in this study could be applicable to a larger audience.

Sanitary conditions in public places have always been a major problem universally, especially in lavatories which are suitable environments for bacterial growth. Mendes and Lynch[1] in a bacteriological survey of institutional toilets and washrooms found evidence of substantial contamination with bacteria of fecal origin. There is indication that even daily disinfection can be inadequate for such toilets[2], especially when bacteria are becoming increasingly antibiotic resistant in the restrooms[3,4]. Even with modern sanitation management of public lavatories, a recent bacteriological investigation in South Korea implied there was a need for improvement[5]. Furthermore, there are obvious concerns for the potential of cross infection risks from such contamination.

Schools, having a high-density occupation, should especially be required to provide a safe environment for their students. Nonetheless, there is increasing teacher and parental concerns regarding the possible roles hygiene and bacterial contaminants have in school buildings[6]. A recent study for school-age children in the USA established that gastrointestinal symptoms are frequent somatic grievances among children[7]. Several studies have examined the prevalence of diarrheal diseases in schools and university campus settings, attributing it to the microbial contamination of hands, surfaces, and objects[8,9]. High bacterial contamination was detected in 52.9% of student's hands in Crete schools, with boys exhibiting higher levels of contamination than girls[10]. Therefore, these areas of concern need to be continually checked for cleanliness in order to prevent the spread of infections and disease.

E. coli (*Escherichia coli*) is an indicator bacterium whose presence is used to indicate the presence of a potential health risk. Some strains of the bacterium are potentially deadly in which people can infect each other through a fecal-oral route and by person-to-person contact. Moreover, *E. coli* also has a low infectious dose and is somewhat difficult to kill[11]. Furthermore, it has been stated that 80% of infectious diseases are spread by touch[12]. Therefore, infectious transmission from *E. coli* becomes even more likely in high human density settings such as schools.

Lavatories are especially vulnerable to bacterial contamination. Since bacteria require moisture to proliferate, standing water, water-damaged materials, or wet surfaces in lavatories can serve as a breeding ground for contamination. Since Bacteria adhere more readily to wet hands, there is an increased risk of cross-contamination in lavatories[13]. In one study, Khan[14] has illustrated the role of inadequate hygiene in school toilets in helping spread dysentery among students. Another study has shown that bacteria such as *E. coli* can subsist on the toilet seats for an indefinite period[15]. Molotch and Norén[16] have shown that a toilet seat typically can have on average more than 7 bacteria per square centimeter.

1.1 School Cleaning Routine

The cleaning and disinfecting of lavatories in public schools in Kuwait are out-sourced to the private sector. Through a contract tendered by the Ministry of Education in Kuwait, the cleaning contractor is required to perform a daily cleaning operation. The observed cleaning operation involved two people equipped with the required tools, detergents, and antiseptics. The cleaning operation lasted about 30 minutes for one lavatory facility. The operation took place early in the morning before classes commenced.

A written or approved cleaning procedure to be followed by the custodial crews performing the cleaning operation at the schools was not found by the investigators. It was common practice for both the cleaning staff supervisor and the school deputy principal, acting as a quality control team, to make a daily inspection of the lavatories to ascertain whether the cleaning operation satisfied the subjective quality level.

1.2 School Building Architecture

There are 132 gender segregated public secondary schools in Kuwait. These schools can accommodate between 400 and 750 pupils each. The architecture of the schools reveals two-floor buildings with lavatory facilities containing three to five toilet cubicles on each floor. The door handles in the cubicles were found, generally, be either broken or missing. The toilets are either of European (seat) or Asian (squat) style (Figure 1a, b). Single exhaust fans vented to the outdoors were found in each stall, but in general, were not functioning.

Figure1. A typical European seat style toilet (a) and an Asian squat style toilet (b) found in one of the schools

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Private schools in Kuwait are more varied in architecture and are mostly co-educational. Since these schools are comparatively small in number and differ in structure, they were not considered for this study.

1.3 Research Objectives

In the current investigation, assessment of the prevalence of *E. coli* bacterial contamination and the adequacy of cleanliness of the lavatories in public school buildings in Kuwait are conducted.

Since skin-to-surface contact is inevitable within the lavatory environment, there is the opportunity for bacterial spread. Thus, expected bacteria hotspots in the lavatories were investigated and the dependency of cross-contamination of the surfaces within the toilet area due to the frequency of skin-to-surface contact.

There is some discrepancy in the literature as to whether girls or boys are more susceptible to bacterial infection in schools. In one report, boys exhibited higher levels of contamination[10]. In another report, the prevalence rate of bacterial infection among boys and girls of school age were 16.9% and 22.0% respectively, with *E. coli* (30.8%) being the most common type of infection[17]. Therefore, a further objective of this research will investigate the contamination level between the genders based on the cleanliness of their respective lavatories.

Finally, a contamination level comparison is assessed between lavatory fixtures (i.e. seat and squat toilets). The sampling results are statistically analyzed to determine if one type of fixture is actually more sanitary than the other.

2. Materials and Methods

2.1 Sampling

Of the 132 high schools in Kuwait, 46 gender segregated high schools were chosen as a sampling size for this research. The number of schools chosen signified a suitable statistical number (or above 30% of the total number of schools). Figure 2 shows the sites of these schools, which are located throughout all the urban locations in Kuwait. Of the schools selected, 24 were for females and 22 were for males. The schools chosen differed in age with the oldest school being constructed in 1959 and the most recent school built in 2010. Table 1 shows some relevant data regarding high schools in the State of Kuwait.

Notes: (1) Labeed Iben Rabeea'a, (2) Um Al-Hakam Bent Aby Sufyan, (3) Abdulateef Thnyan Al-Ghanim, (4) Anas Iben Malek, (5) Abraq Kheetan, (6) Ruzainah, (7) Al-Rabee'a bent Mua'aawath, (8) Al-Kendy, (10) Al-Ahmadi, (11) Al-Retqqa, (12) Al-Zoor, (13) Fatema Al-Hashemyah, (14) Sabah Al-Salem, (15) Sabah Al-Salem, (16) Mohammed AL-Meheani. (17) Al-Jahra, (18) Um Al-Hareth Al-Anssaryah, (19) Al-Nawar Bent Malek, (20) Salwa, (21) Al-Jabryah, (22) Jaber Al-Ahmad Al-Sabah, (23) Abdullah Abdulateef Al-Rejeeb, (24) Fatema Al-Sara'awy, (25) Nasser Abdul. AL-Saeed (26) Saad Ben Rabeea' (27) Abdullah Al-Jaber Al-Sabah, (28) Lateefa Al-Shemali, (29) Suaad Bent Salamh, (30) Yousef Ben Essa, (31) Al-Jazae'r, (32) Al-Mansouryah, (33) Al-Yarmouk, (34) Sabah Al-Salem, (35) Jahra, (36) Al-Emam Malek, (37) Al-Mubarakeyah, (39) Balat Al-Shuhada'a (40) Fatema Bent Asad (41) Omar Ben Al-Khata (42) Al-Shargeyah, (43) Falasteen, (44) Al-Furdous, (45) Um Al-Heaman, (46) Al-Jazae'r

Figure 2. The localities of the 46 schools in Kuwait employed in the present research are shown with chosen schools are limited to urbanized areas (about 11% of the country)

Table 1. Relevant statistical data for some components of the high school educational system in the State of Kuwait[18]

Category	Total
High schools in Kuwait	132
High schools for girls	69
High schools for boys	63
Female high school students	40119
Male high school students	31129
Female high school staff members	6669
Male high school staff members	5352

In advance of the testing, each school was visited by a member of the research team in order to both familiarize

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the school administration with the study and to expedite the research undertaking. Beforehand, an official letter from the Ministry of Education was sent to the administration of all the chosen schools with a request of assistance for the research team.

2.2 Microbiological Testing

Bacterial detection was performed with swab samples taken from the lavatories. The swabs were collected during an interval from October 2017 to May 2018. Testing of the swabs was performed using the MicroSnap *E. coli* test system, manufactured by Hygiena International Limited. Briefly, MicroSnap *E. coli* is a swift test for revealing and enumeration of *E. coli* bacteria. The test incorporates two different phases; the first phase is an enrichment of the specimen in a nutrient-rich broth apparatus at 37±0.5°C. After 8 hours, an aliquot is removed from the enrichment apparatus and inserted into the Coliform Detection Device, which is then assayed in a bioluminogenic (light-producing) substrate after 10 min of incubation at 37±0.5°C. Specimens testing positive in the Coliform Detection Device can be then assessed precisely for *E. coli* by means of the *E. coli* Detection Device. The results from this testing system have been previously validated by Meighan[19] for the detection of *E. coli* at very low levels and in a variety of sample types. The MicroSnap device was previously calibrated and prepared for use by the manufacturer. The readings were retrieved from the device with outputs in CFU (Colony Forming Units)/ml (Table 2). To exclude any errors, an average reading for the 3 swabs from each surface was recorded to ascertain the level of contamination.

Table 2. Equivalence readings between RLU units values of *E. coli* bacteria obtained by MicroSnap kit and the colony forming units (CFU)

RLU values	Equivalence colony forming units (CFU)
	EnSUR
≤10	≤40
30	125
100	300
300	800
1000	2,000
3000	5,500
10,000	15,000
30,000	Above display range
100,000	Above display range
300,000	Above display range
1,000,000	Above display range

Data collection using the MicroSnap kit for a selected lavatory took approximately 20 minutes and was conducted mid-day during school operating hours after the early morning custodial cleaning. In accordance with the test kit's instructions, three duplicate swab samples were aseptically collected from three surfaces in each lavatory to test for *E. coli* bacteria prevalence. This resulted in a total of nine samples taken per lavatory. The surfaces in the lavatory selected for the swab samples were decided upon based on the surfaces most commonly coming into human contact (hotspots) and what style of toilet was found.

The lavatory facilities allocated to pupils in the school buildings were randomly selected for the microbiological testing while ensuring that at least one lavatory was selected on each floor level. The researcher first noted whether the lavatory facility had European or Asian type toilets. In the case an Asian style toilet was encountered, three duplicate swabs were each taken from the flushing handle and the bidet shower handle (as shown in Fig. 3), in addition to the sink taps. When a European style toilet was encountered, three duplicate swabs were each taken from each of the flushing handle, the bidet shower handle, and from the toilet seat as illustrated in Fig. 4.

Figure 3. An Asian style toilet indicating where the swab samples were taken

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Figure 4. A seat style toilet showing the three locations where swab samples were taken

2.3 Statistical Analysis

IBM SPSS (version 22) statistical analytical software was used for the research data analysis. A Chi-square test was implemented to ascertain the dependency among the selected data. In addition, F-test and T-statistics were used to compare two independent sample means for unequal and equal variances, respectively.

3. Results and Discussion

The sampling results are shown in Table 3 for each corresponding school. The results showed *E. coli* was non-existent in 85% of the schools tested, while 15% of the schools tested, showed the existence of *E. coli* with varying concentrations. Also, from the 46 sample points tested, 15.2% showed the presence of *E. coli*. This result can be compared to the previously mentioned study by Mohamed et al.[4] which showed that 18% of their samples indicated *E. coli* in public lavatories found in a U.S. metropolitan city.

Table 3. *E. coli* bacteria prevalence in 46 high schools which were randomly selected with 3 duplicate swab samples aseptically collected from 3 surfaces (flush handle, shower bidet, and seat) in each lavatory

No.	School Name	Flush Handle Reading (RLU)	Bidet shower Reading (RLU)	Seat Reading (RLU)
1	Al-Mansouryah	0	0	0
2	Essa Ahmed Al-Hamad	0	0	0
3	Lateefa Al-Shemali	0	0	0
4	Saad Ben Rabeea'a	0	0	0
5	Abdullah Al-Jaber Al-Sabah	0	0	0
6	Al-Jazae'r	0	0	0
7	Yousef Ben Essa	0	0	0
8	Al-Yarmouk	0	0	0
9	Jaber Al-Ahmad Al-Sabah	0	0	0
10	Abdullah Abdulateef Al-Rejeeb	0	0	0
11	Salwa	0	0	0
12	Falasteen*	1	1	4
13	Al-Jabryah	0	0	0
14	Fatema Al-Sara'awy	0	0	0
15	Nasser Abdulmuhsen AL-Saeed	0	0	0
16	Al-Kendy	0	0	0
17	Al-Zoor	0	0	0
18	Fatema Bent Asad	0	0	0
19	Um Al-Heaman	0	0	0
20	Lateefa Al-Fares	0	0	0
21	Al-Ahmadi	0	0	0
22	Balat Al-Shuhada'a	0	0	0
23	Omar Ben Al-Khatab	0	0	0
24	Al-Retqqa	0	0	0
25	Al-Emam Malek	0	0	0
26	Abdullah Mubarak Al-Sabah*	1	2	1
27	Fatema Al-Hashemyah	0	0	0
28	Sabah Al-Salem	0	0	0
29	Al-Shargeyah	0	0	0
30	Sabah Al-Salem	0	0	0
31	Abraq Kheetan	0	0	0
32	Al-Mubarakeyah	0	0	0
33	Ruzainah	0	0	0
34	AnasIbenMalek	0	0	0
35	Labeed Iben Rabeea'a*	26	27	20
36	Abdulateef Thnyan Al-Ghanim*	25	28	22
37	Al-Rabee'a bent Mua'aawath	0	0	0
38	Um Al-Hakam Bent Aby Sufyan	0	0	0
39	Al-Furdous	0	0	0
40	Al-Jahra*	2	1	0
41	Al-Nawar Bent Malek**	2	3	1
42	Mohammed AL-Meheani	0	0	0
43	Um Al-Hareth Al-Anssaryah	0	0	0
44	Al-Jahra	0	0	0
45	Jaber Abdullah Al-Sabah*	2	5	2
46	Suaad Bent Selameh	0	0	0

Notes: *Boys' schools with *E. coli* bacteria prevalence with various values.

**Girls' schools with *E. coli* prevalence for its 3 tested contact surfaces.

The results depict two main observations; first, out of the 7 schools, only 2 schools indicated considerably high values with respect to other schools. Unlike the rest of the schools, it was observed that the sampling results for

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the flush handle, shower bidet, and seat were in the higher range (20-30 RLU). Second, 6 schools were for boys, while only a single school was for girls. Fig. 5 shows the three duplicate swab results for the flush handle, shower bidet, and seat in each lavatory of the 7 schools with high *E. coli* bacteria prevalence. For instance, the sampling results for Abdulateef Thnyan Al-Ghanim male high school had *E. coli* concentration values for flush handle, washing bidet, and toilet seat of 25, 28, and 22 RLU, respectively.

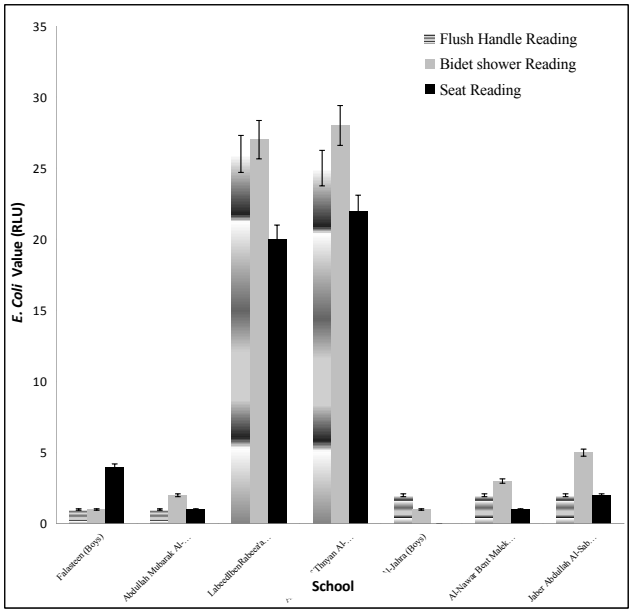

Figure 5. *E. coli* bacteria results of three sampling contact points (flush handle, shower bidet, and seat) in RLU units for 7 schools (representing about 15%) out of 46 schools.

3.1 Dependency Relation of the Three Sampling Surface Points

In order to answer the question of whether there is a difference between the sampling locations (hotspots), namely the Flush Handle, Washing Bidet and Seat, within the same methodology or otherwise, a correlation and Chi-squared tests were used to ascertain such a hypothesis. The Chi-squared test of independence variables was applied to resolve the question of whether the influences of one variable depend on the value of another variable. Therefore, a correlation between the three sampling locations in a sequence manner was implemented as shown in Table 4.

Table 4. Statistical correlation test among the three sampling surfaces (flush handle, shower bidet, and seat) in each lavatory to test the prevalence of *E. coli* bacteria in 46 schools with correlation significant at the 0.01 level (2-tailed)

Correlations		Washing Bidet		
		Flush Handle Readings (RLU)	Readings (RLU)	Seat Readings (RLU)
Flush Handle Readings (RLU)	Pearson Correlation	1	.996*	.990*
	Sig. (2-tailed)		.000	.000
	N	46	46	46
Washing Bidet Readings (RLU)	Pearson Correlation	.996*	1	.990*
	Sig. (2-tailed)	.000		.000
	N	46	46	46
Seat Readings (RLU)	Pearson Correlation	.990*	.990*	1
	Sig. (2-tailed)	.000	.000	
	N	46	46	46

The statistical results depicted in Table 4 show a high correlation of Pearson Correlation "r" with more than 0.99 between the three surfaces under consideration. The correlation between Flush Handle and both Washing Bidet and Seat recorded "r" equal to 0.996 and 0.990, respectively. Similarly, the correlation between Washing Bidet and both flush Handle and Seat revealed a high correlation of 0.996 and 0.990, respectively. In addition, the correlation of Seat and both flush Handle and Washing Bidet showed "r" to be equal to 0.990 for both readings, which indicated a high correlation.

In an attempt to thoroughly verify if one surface sampling represented the rest of the sampling points, a Chi-squared test was implemented. The Chi-squared test of independence variables is used to answer the question of whether the effects of one variable depend on the value of another variable.

Investigating the correlation between Flush Handle and Washing Bidet readings, a null hypothesis (H0:) indicated that the readings of "Flush Handle" and "Washing Bidet" were independent of each other [H0: $\Sigma\Sigma(O - E)2 = 0$], where "O" and "E" represent the actual observation and expected reading value respectively of the mentioned variables. The hypothesis (H1:) indicated the opposite. In other words, readings of "Flush Handle" and "Washing Bidet" were not independent of each other. Therefore, readings in "Washing Bidet" is dependent on readings in "Flush Handle" [H1: $\Sigma\Sigma(O - E)2 \neq 0$]. The value of the Chi-squared statistics shown in Table 5 is presented in $\chi^2 = 164.8$ with a p-value of less than 0.001. Consequently, the

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decision was to reject the null hypothesis (H_0:) at a significance level of less than 1% (α=0.001). As a result, the readings of "Flush Handle" and "Washing Bidet" are dependent and represent each other significantly. Therefore, according to the data and the results, if *E. coli* exists on the "Flush Handle", it is expected to be also existent on the "Washing Handle" as well and vice versa.

Table 5. Chi-square test table representing the dependency correlation between the "Flush Handle" and the "Washing Bidet" readings

Title	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.648E2*	24	.000
Likelihood Ratio	54.340	24	.000
Linear-by-Linear Association	44.601	1	.000
N of Valid Cases	46		

Notes: *Has 34 cells according to the statistical package (SPSS) representing 97.1% with an expected count less than 5 and the minimum expected count is 0.02

In addition, a similar hypothesis was suggested for the correlation between Flush Handle and Toilet Seat readings. Again, the null hypothesis is (H0:) for this scenario and indicated that the readings of "Flush Handle" and "Toilet seat " are independent of each other. The values of the Chi-squared statistic, as indicated in Table 6, shows that χ^2= 148.7 with a p-value less than 0.001. As a result, the decision was to reject the null hypothesis (H0:) at a significant level less than 1%. Hence, the readings of "Flush Handle" and "Toilet Seat" are dependent on each other.

Table 6. The Chi-square test represents the dependency correlation between the "Flush Handle" and the "Toilet seat" readings

Title	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.487E2*	20	.000
Likelihood Ratio	44.988	20	.001
Linear-by-Linear Association	44.085	1	.000
N of Valid Cases	46		

Notes: *Has 34 cells according to the statistical package (SPSS) representing 97.1% with an expected count less than 5 and the minimum expected count is 0.02

For the third and last comparison, a hypothesis was questioned between the "Washing Bidet" and the "Toilet Seat" Readings. The null hypotheses (H0:) for this scenario stated that the readings of the "Washing Bidet" and the "Toilet seat" were independent of each other. The value of the Chi-squared statistic, as indicated in Table 7, shows that χ^2= 206.4 with a p-value less than 0.001. As a result, the decision was to reject the null hypothesis. Therefore, the analysis rejected the null hypotheses (H0:) at a significant level less than 1%. Consequently, the readings of the "Washing Bidet" and the "Toilet seat" are dependent on each other.

Table 7. The Chi-square test represents the dependency correlation between the "Washing Bidet" and the "Toilet seat" readings

Title	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.064E2*	30	.000
Likelihood Ratio	51.579	30	.008
Linear-by-Linear Association	44.103	1	.000
N of Valid Cases	46		

Notes: *Has 34 cells according to the statistical package (SPSS) representing 97.1% with an expected count less than 5 and the minimum expected count is 0.02

Accordingly, it can be stated with high confidence that the three sampling locations (flush handle, shower bidet, and toilet seat) are dependent and highly correlated with not less than a 99% confidence level. Thus, taking samples from any one of the aforementioned "hotspot" locations obviates the other two. This would reduce researcher cost, effort, and time for data gathering procedures.

3.2 Correlation of Male and Female Readings

The previous section addressed the dependency of the three sampling points, where it was concluded that one sampling point could represent other sampling points. Therefore, the researcher could implement sufficiently the correlation of male and female readings analysis using only the "Flush handle" data.

To ascertain the correlation between the readings of both genders and the readings of the tested data, a comparison of the *E. coli* bacteria data for two independent samples, namely male and female, were tested. A tested hypothesis (H_0:) was included if the toilets in the male and female schools had a similar reading. Table 8 depicts the test for equality of variances. According to the F-test, male and female readings have unequal variance since the significant P-value is 0.002, which is less than the significant level 0.01. Therefore, the F-test indicates that the male and female readings have unequal variances. As a result, the t-statistics of equal variances is not assumed. Results indicated that Sig. (2-tailed) is equal to 0.129, which indicates accepting the null hypothesis. Therefore, it was concluded that male and female data could have equal readings.

In a further analysis to test whether male toilets read-

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Table 8. Independent Samples analysis of variance of E. coli concentration readings between male and female lavatories

		Levene's Test for Equality of Variances		*t*-test for Equality of Means						
		F	Sig.	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Flush handle RLU	Equal variances assumed	10.325	.002	1.650	44	.106	2.50758	1.52019	-.55618	5.57133
	Equal variances not assumed			1.578	21.116	.129	2.50758	1.58901	-.79585	5.81100

ings had less or equal prevalence of *E. coli*, a null hypothesis was tested. The Null hypothesis (H_0:) projected whether male toilets had less than or equal readings to female toilet readings [H_0:$\mu_{male} \leq \mu_{female}$]. Analytical results from Table 8 showed that male and female readings have unequal variance. Therefore, the decision is to reject the hypothesis at the 10% level of significance ({0.129/2= 0.0645} < 0.1). In other words, it is concluded that male toilets readings have greater *E. coli* prevalence than female toilets readings at only a 10% level of significance.

Table 9 shows male and female means significantly different, however their readings could also be equal. Such a fact is supported by the salient readings of *E. coli* bacteria with no prevalence. However, as previously observed, the male toilets readings have greater *E. coli* concentration than Female toilets readings at only a 10% level of significance. Such a result supports the findings in the study previously done by Kyriacou et al.[10].

Table 9. Group statistics for the measured data of 22 male and 24 female lavatories

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Flush handle RLU	Male	22	2.5909	7.44286	1.58682
	Female	24	.0833	.40825	.08333

3.3 Data Variance of European "Seat" and Asian "Squat" Type Toilets

In an effort to test the differences in data between European seat and Asian squat style toilets, the readings were tabulated and analyzed. Descriptive data statistics of the two styles of toilets are presented in Table 10.

Table 10. Group statistics for the measured data of 23 Asian squat and 23 European seat toilets irrespective of gender

	Sampling position	N	Mean	Std. Deviation	Std. Error Mean
Toilet Seat RLU	Asian "squat"	23	2.0000	6.02268	1.25582
	European "seat"	23	.1739	.83406	.17391

Equality of Variances for the data gathered from the European seat and Asian squat toilets were tested as illustrated in Table 11. According to the F-test, European seat and Asian squat toilets had unequal variance since the "seat" readings P-value was 0.007, where it is less than the significant level (0.01). Consequently, in this case, t-statistics of "Equal Variances is not assumed" had to be implemented. Accordingly, the null hypothesis was not rejected. Therefore, the analytical conclusion indicated that there was probably no difference between European seat or Asian squat toilets. However, Asian squat toilets could have greater readings than the European seat toilet at only a 10% level of significance.

4. Conclusions

Since schools should be obligated to provide a safe environment for their students, the present research has been conducted on the prevalence of *E. coli* in 46 public schools in Kuwait. The study involved microbiological testing of 342 stool samples collected from selected lav-

Table 11. Independent samples analysis of variance table testing Asian "Squat" and European "Seat" toilets of E. coli bacteria prevalence for male and female lavatories

		Levene's Test for Equality of Variances		*t*-test for Equality of Means						
		F	Sig.	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Seat Readings RLU	Equal variances assumed	7.984	.007	1.440	44	.157	1.82609	1.26780	-72900	4.38117
	Equal variances not assumed			1.440	22.844	.163	1.82609	1.26780	-79755	4.44973

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atory surfaces. The results of the testing for the spread of the *E. coli* bacteria were categorized by total count, sampling location dependency, contamination level comparison between genders, and lavatory fixtures (i.e. seat and squat toilets) supported by applying appropriate statistical analysis.

The sampling results indicated some contamination concerns. A total of seven schools showed the existence of *E. coli* (or 15% of the schools tested) with varying concentrations. Of these seven schools, two schools indicated considerably high values with respect to the other schools.

The results also revealed, with the aid of statistical analysis, cross-contamination between surfaces in the lavatory stalls, and thus, sampling location dependency. Therefore, it can be stated with high confidence that the three sampling areas (flush handle, shower bidet, and toilet seat) are dependent. As a result, taking any sampling position obviates the other two areas. This would reduce researcher cost, effort, and time for data gathering procedures.

In addition, analytical results showed that the boys' lavatory readings have greater *E. coli* prevalence than the girls' toilets, and thus, are less sanitary.

Finally, it was determined from the data gathered that the Asian squat style toilets are more contaminated than the European seat style. It might be prudent to reconsider the use of squat style toilets in the architectural layout of any future school building.

The results suggest some schools in Kuwait have a contamination problem and that there is a threat of bacterial infection that can spread among students via contaminated hands and surfaces in the lavatory areas. Therefore, improved environmental hygiene and enhanced sanitation are needed in these "problem" schools and the daily cleaning operation at these schools is not sufficient.

5. Recommendations

Certain schools investigated in this research have *E. coli* levels high enough to create health concerns for students. This information necessitates improving public health hygiene through a multi-level approach to the prevention of *E. coli* exposure. The suggested policies and methods would be remedial by way of additional research, education, and an administrative program.

By regulating the relative humidity level in a lavatory, the growth of bacteria can be reduced. A relative humidity of 30 to 50 percent is suggested and satisfactory ventilation would introduce sufficient outdoor air to assist in the decrease of humidity, especially in a hot-arid climate like the one found in Kuwait. Therefore, the lavatory exhaust fans need to be properly maintained and functioning.

It is recommended as a result of this research to increase the frequency of the current cleaning routine of once per day to twice or more per day during school operating hours, especially for the boys' lavatories. The Ministry of Education should also adopt a written cleaning standard that is implemented by the hired cleaning contractors in order to improve hygiene in the schools. The standard should include, in addition to cleaning frequency, the provision of adequate infection controls and accepted anti-bacterial detergent usage.

Other methods of effective cleaning could also possibly be introduced. For example, a continuous-release hypochlorite disinfectant system may be utilized. The continuous release system can produce a considerable and continuous reduction in contamination of the toilet and surrounding areas[2].

Also, the outcomes of this research are a task for legislators. Numerous countries have health laws that entail school inspections to safeguard hygiene quality measures. Some of these laws dictate that local health agencies to perform the inspections. The State of Kuwait is still deficient in such health laws for implementing satisfactory hygiene measures for schools. This is a chance for policymakers to become promoters for the safeguard of children's environments and prevention of exposure to bacterial contamination.

At the school level, grasping the significance of good hygiene is imperative in establishing a successful health program. Health and environment specialists have a part to play in helping school administrators understand how bacterial complications progress, the significance of suitable hygiene, and its effect on students and staff. School nurses should be prepared and qualified to identify situations of bacterial exposure.

Long-term testing and sampling during school hours was not conceivable in this study owing to the disruption it would have caused to the schools. However, when the population studied is a sensitive group, there is a certain necessity to test continuously. Thus, the several schools tested to have elevated *E. coli* measurements are candidates for long-term monitoring.

Additional analyses are also required to establish the reasons for the measured divergences between the schools and to conclude if the initial school sites used in this study are illustrative of actual exposures in other surrounding schools that were not tested in this study. Discrepancies might also be present in other educational facilities such as university, middle, and primary school buildings and this is a topic for further study.

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ARTICLE

"Integrated" Solution and Engineering Application of Assembled Cable-Stayed Pedestrian Landscape Overbridge

Xinrui Shao*

Macau Environmental Research Institute, Macau University of Science and Technology, Macau, 999078, China

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ABSTRACT

The construction of modern cities emphasizes the nature and harmony among the "people", "things" and "environment", reflecting the harmony and unity of the formal beauty, functional beauty and surrounding environment of architecture. Based on the introduction of the design concept of the assembled pedestrian overbridge, through the Jianhua Building Materials Group's first "pre-fabricated low-rise tower-stayed pedestrian landscape overbridge" project in China, this paper proposes a solution that can improve the landscape design of the overbridge and reduce the construction complexity of the overbridge, the assembly product supply and the construction process "integration" under the premise of ensuring the safety and stability of the pedestrian overbridge, whose prefabricated production and assembly construction, shortening the construction period, reducing energy consumption, reducing pollution, and obtaining good social comprehensive benefits.

1. Introduction

"Pedestrian landscape overbridge" is the window of modern urban culture and city image. Its scheme design, material supply and construction process reflect the ability and level of urban construction and management. The traditional "pedestrian landscape overbridge" project mostly adopts the cast-in-place mode, which faces poor overall performance, long construction period, poor quality stability, and at the same time exacerbates the contradiction between people and vehicles, and is accompanied by various pollutions and other problems. Integrating the development and experience of assembling overbridges in China's outer sections, following the principles of "safety, application, economy, aesthetics, durability and environmental protection", Jianhua Building Materials Group is aiming at the "Nanjing Pukou District Pedestrian Crossing Street Landscape overbridge" project, innovative technology, and adopting "full prefabricated assembled twin tower cable-stayed structure", and the engineering design and technical staff on-site service, draw the design plan, communicate and adjust with the customer, and carry out the full prefabricated production of the product, so that the project can be changed from cast-in-place to pre-assembled, which completely solves the problem that the engineering project is chaotic due

**Corresponding Author:*
Xinrui Shao,
Male, born in January 1996, is a graduate student majoring in environmental science and management at Macau Environmental Research Institute, Macau University of Science and Technology;
Correspondence address: Macau Environmental Research Institute, Macau University of Science and Technology, Taipa Weilong Road, Macau, 999078, China;
E-mail: 1214717549@qq.com.

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to the disjunction between planning and design, material supply and construction, improves the construction efficiency and reduces the impact on the traffic environment.

2. Design Ideas of Assembled Pedestrian Overbridge

2.1 Overall Design Ideas

To maximize the proportion of overbridge factory assembly prefabrication, save installation time, reduce cast-in-place construction process, reduce dust, noise and other pollution, except for underground foundation engineering, the rest of the components are assembled prefabricated. The superstructure main bridge body, stair beam body and overbridge deck pavement layer are assembled by prefabricated sections. The auxiliary components such as railings, expansion joints and lighting can be completed before the assembly according to the requirements of the overall design; the lower pile foundation and the enlarged foundation are completed on site and the piers and cover beams are prefabricated in the factory, and the construction site and the foundation are installed and installed.

2.1.1 Main Bridge Body Design Ideas

(1) The difficulty in assembling the pedestrian overbridge segment is how to avoid the duplication and waste of cost investment and reuse as much as possible to achieve economic benefits. Therefore, the design should not only pay attention to the general performance of the component design for a specific overbridge, which requires analyzing the distribution of the road section in the target area to determine the span of the overbridge span, which can be determined based on the existing overbridge distribution data.

(2) Before the design, the constraints in the construction should be considered. For example, the lifting load and operability of the car are limited. The lifting weight of the beam should not be too large, which is recommended not to exceed 70-80t. The main overbridge adopts equal-section box girder and single-box single-chamber structure; Assembled overbridges need to be prefabricated at the factory, which requires that the choice of beam height in the design should not be too much to pursue the optimal ratio and should be too discrete. Some applicable height modulus should be selected according to the span of the overbridge.

2.1.2 Stair Beam Design Ideas

Stair beam: It has two characteristics with respect to the main overbridge: the appearance of the line shape and the fluctuation range of the span are small. Therefore, in the design, it is more inclined to adopt the flexible connection mode of the steel-mixed section, which is convenient for secondary use after dismantling.

2.1.3 Lower Structure Design Ideas

According to the applicable part, the pier is pre-formed, and the bottom of the column is reserved with flanges, which are connected with the cover beam and the pile foundation by bolts. The abutment, the enlarged foundation and the pile foundation are cast on site.

2.1.4 Affiliated Structures

Railings and drain pipes are reserved for railing joints on the main beam. They can be assembled on the spot before assembly or hoisting. The expansion joints, supports and anti-collision facilities are all shaped products.

2.2 The Advantages of the "Integration" Scheme

2.2.1 Construction Advantages

The engineering innovation adopts a full prefabricated pedestrian landscape structure;

The hoisting and assembling of the low-tower towers are carried out in the side zone, which does not affect the traffic of the current motorway; the lifting of the three prefabricated panels on the top of the motorway is carried out at night. During the day, the anti-drop net protection of the top of the tower column, the tower column and the I-beam set up on the top of the pedestrian stairway cap will not affect the normal driving of the motorway during the day.

2.2.2 Late Maintenance Advantages

Steel fiber concrete wedge extrusion anchoring device is adopted, which has strong durability and corrosion resistance; the cable stays with low-relaxation super-strength galvanized steel wire, and the cable life can reach 30 years, exceeding the standard requirements of 20 years.

2.2.3 Construction Period Advantages

The overall construction period is shortened by half (the traditional construction period is 6 months and the current construction period is 3 months).

3. Engineering Application Case

3.1 Case Background

Puzhu North Road, Pukou District, Nanjing is an import-

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ant passage to the Yangtze River Tunnel. There are four large residential quarters and the Australian Forest Shopping Plaza on the west side of the Puzhu North Road. Therefore, the traffic volume is large and people Large flow rate; traffic status: The residents on the south side of the residential area to the north side of the bus stop need to go to the Puliu intersection to bypass the distance of about 600m. Therefore, the addition of a pedestrian crossing overbridge at the site can better alleviate the travel needs of surrounding residents and reduce the traffic safety hazards that may result from the crossing of guardrails and crossing roads.

3.2 Structural Design

The full width of the overpass main overbridge is 5.06m, the net width is 4.0m; the span is arranged as: (10+34+10) m; it is a prefabricated assembled low-rise tower cable-stayed overbridge with a main span of 34m and a side span of 10m. 2.8m ramp and stairway; the overbridge deck of the main overbridge is a reinforced concrete overbridge deck with side main beams, with a beam height of 0.45m-0.55m and a plate thickness of 0.2m. The main tower is a garden-shaped tower column, and the above-mentioned overbridge beam is a rectangular hollow steel pipe with a tower height of 8.1 m; below the overbridge beam, the concrete-filled steel tubular pier with a rectangular section is 6.72m high. The stay cable is a steel strand + PE sheath, and the ends are anchor head anchors, which are respectively anchored on the steel tower column and the side main beam. Its engineering structure design is shown in Figure 1:

Figure 1. Project structure design drawing

3.3 Structural Calculation

The analysis model of cable-stayed overbridge was established by using Midas Civil finite element software. The whole overbridge is divided into 118 units and 123 nodes, of which the cable is only the truss unit and the rest parts are beam units. The boundary conditions consist of 6 general supports and 22 elastic connections. The analysis model of the cable-stayed overbridge is shown in Figure 2 below:

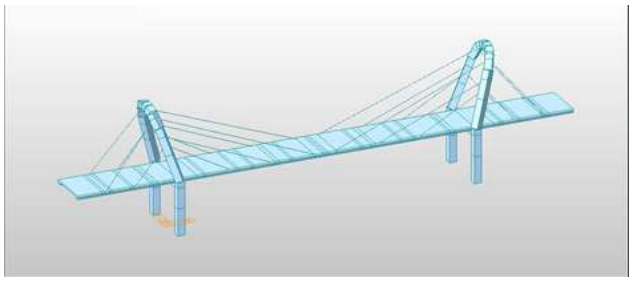

Figure 2. Cable-stayed overbridge analysis model

3.4 Construction Scheme

3.4.1 Construction Preliminary Scheme Design and Steps

(1) The cable-stayed overbridge deck adopts cantilever assembly construction method, and the construction process is foundation pile foundation construction—cap construction —main tower construction—overbridge cantilever assembly—stayed cable tension anchorage—overbridge deck closure;

(2) The No. 3 prefabricated overbridge deck supported on the main tower beam shall be temporarily consolidated first, and the temporary consolidation shall be released after the overbridge deck is closed, and the permanent support shall be placed;

(3) The main tower is prefabricated in sections, and the steel pipe should be welded to maintain the vertical and horizontal lines of the main tower. The stay cable is anchored after the tensile stress of the design. When anchoring, it should be noted that the offset angle of the stay cable is consistent with the design value;

(4) When assembling all prefabricated blocks, attention should be paid to the alignment of the anchored steel bars with the reserved holes and filled with mortar;

(5) The dimensions of each section shall be strictly controlled during the prefabrication of each section, and shall be pre-assembled before the formal assembly to adjust the size of the prefabricated section;

(6) After the construction of the structural system is completed, the overbridge deck leveling layer and the waterproof layer are constructed;

(7) The reinforced concrete overbridge deck is connected to the main truss by pre-embedded studs, paying attention to the reserved holes.

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3.4.2 Superstructure Construction Plan and Steps

Side brackets and non-motor vehicle lanes are erected with door brackets → hoisting + assembling main towers → assembling non-motor vehicle road top prefabricated panels + installing tension cable stays → using the first prefabricated panel at the top of the motor vehicle lane at night + Install the first stay cable → install the anti-drop net with the tower column to strengthen the safety protection measures during the day → install the second and third motor vehicle road top prefabricated panels in the night and install the second and third diagonal stay cables.

3.4.3 Main Beam Construction and Steps

(1) The short platform composite type pull-type hanging basket construction process (YJGF16-98 method): it consists of a hanging basket platform, a tripod and a servo system (staying system, suspension system, walking system, anchoring system, horizontal support system, fine-tuning positioning system);

(2) The cable system uses the stay cable to transmit the vertical load of the front end of the hanging basket to the main tower of the cable-stayed overbridge, and reduces the vertical load of the hanging basket on the main beam. Another function of the pulling rope is to complete the system conversion, that is, the cable is anchored on the hanging basket during construction, and the cable is anchored on the main beam after construction; during the suspension process of the main beam, the hanging basket platform is suspended by the front suspension bar and the pulling rope of the tripod to jointly bear the weight of the beam section;

(3) After the main beam is assembled, the rope is unwound from the front section of the platform and converted into a permanent beam of the main beam; the fulcrum of the walking boom is moved from the tripod to the main beam, and the template is lowered along the front and rear booms of the tripod by a main beam height, and the template is respectively hung by the hook and the running boom;

(4) Raise the front and rear booms to move the tripod forward, and the hooks move along the beam rails and the travel booms along the tripod rails to move the formwork platform to a new position; lower the front and rear booms and reconnect them to the formwork platform. The completion effect of all the projects in this case is shown in Figure 3 below:

Figure 3. Project completion effect drawing

4. Conclusion

The first case of Jianhua Building Materials Group's innovative use of the "pre-prefabricated low-rise tower-stayed pedestrian landscape overbridge" project in the construction of modern cities in China, which is based on its strong R&D and innovation capabilities and comprehensive service capabilities, and cooperates with construction units to connect the entire industrial chain of design, production, construction and management to provide an integrated "integrated" solution; in 2016, the "Guiding Opinions on the Development of Prefabricated Buildings" issued by the State Council of China proposed to use 10 years or so to increase the proportion of fabricated buildings in new construction areas from less than 5% to 30%. As an industry benchmarking enterprise, how to use the modern BIM method and 3D technology to realize the industrial chain standardization, scale and integration is a new exploration and practice topic in modern urban planning and construction.

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REVIEW

Planning and Orientation Analysis of Urban Environmental Landscape Aesthetic Value

Wei Wei*

Dalian Architectural Design and Research Institute Co., Ltd., Dalian, Liaoning, 116000, China

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ABSTRACT

Landscape is people's evaluation of the environment which is better and more meaningful to visit. Therefore, a landscape must have a good environment. Landscape exists in nature as well as in cities. Every corner of a city can be a landscape. Its connection with the city and the citizens is inseparable. However, due to the acceleration of urbanization, there are still many problems in the urban environment. To solve these problems perfectly, we should work from the aesthetic value and planning orientation of the landscape. Therefore, this paper discusses and analyzes the problems of urban environment and how to use the aesthetic value and orientation to construct urban environmental landscape.

1. Introduction

The urban landscape is mainly a structure with natural aesthetic elements, artificial elements and other elements, which are mainly composed of buildings and have a certain aesthetic value by adjusting the external space environment of the building. The study on the aesthetic value of urban landscape can provide a reasonable approach for urban planning and design. Therefore, in order to promote the full play of urban environmental landscape aesthetic value, the planning and analysis of urban environmental landscape aesthetic value is of great significance.

2. The Status Quo of Urban Environmental Landscape Aesthetics in China

The aesthetics of the landscape of the urban environment involves many fields. From an aesthetic perspective, it is a picture that is primarily formed by multiple visual perceptions. Judging from the subjective consciousness of the subject person, it is an image that combines emotion and vision. Based on the ecological perspective, the landscape aesthetics of the urban environment promotes a stable balance between related elements within the city. China is now in a period of accelerated urbanization. Therefore, a high degree of urbanization is bound to affect the city's appearance. The urban environment landscape is not just

**Corresponding Author:*
Wei Wei,
Dalian Architectural Design and Research Institute Co., Ltd., No. 102 Shengli Road, Xigang District, Dalian, Liaoning, 116000, China;
E-mail: 352278250@qq.com.

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about the surface, but the cultural connotation should also be paid attention to. However, it is difficult for citizens to feel the sense of belonging and participation in the urban environment and landscape. In urban landscape design, urban construction generally lacks comprehensive consideration of many aspects, such as cultural connotation and aesthetic connotation. Just because urban construction does not pay attention to culture and aesthetics, and does not combine urban construction with human factors, many famous historical cities in China have disappeared in the modern urban construction. The modern urbanization construction is greatly influenced by the developed countries in Europe and America. Therefore, the modern city construction comparatively pursues the speed but ignores the quality and the connotation. As a result, the cultural deposits of the city are not fully explored, and residents have no strong sense of belonging to the city, and it is difficult to integrate into the urban environment.[1]

3. Landscape Aesthetics with Beauty, Delicacy and Connotation

An important indicator of whether an environment is beautiful is the aesthetic value of the landscape. In order to determine the design value of an urban environmental landscape aesthetics, it should be determined from social functions to determine the quantitative criteria. However, the value of urban environmental landscape aesthetics is determined to be different and there is no uniform standard. However, there are some regularities in urban environmental landscape. These laws are summarized in the long-term residential process. These aesthetic laws are mainly manifested in three characteristics to express beautiful and delicate landscape aesthetics without losing its connotation.

The first characteristic is nationality. Due to the different living environment and geographical environment, the aesthetic concepts of different regions and ethnic groups will be different. There are many ethnic groups in China, and their living habits and living environment are also different. Therefore, the aesthetic concept is diverse. A variety of aesthetic views will have a variety of aesthetic consciousness. In this way, people of different ethnic groups have different judgments on urban environment. Therefore, there will be distinct ethnic and regional characteristics.

The second characteristic is iconic. The boutique architectural design is the main detail of the aesthetics of the urban environment. On the one hand, urban environmental landscape planners should expand the visibility and comprehensive utilization of internal landmark buildings and sculptures. On the other hand, in the form of the construction of a comprehensive cultural and artistic center, modern urban construction, historical and cultural monuments and natural landscapes are organically integrated.[2]

The third characteristic is intuitive. This is the most direct feeling of people, that is, people see various spatial objects in the environment. It is an aesthetic consisting of buildings, plants, animals and visitors. This is people's direct experience of the urban landscape.

4. The Pursuit of Unique Aesthetics and the Creation of Aesthetic Interest

Cities are one of the carriers of culture. On the one hand, cities are created by people; On the other hand, cities are also influencing and changing people. Cultures are different. Therefore, different areas of urban landscape have different styles, and the landscape between cities also has its own characteristics. Three principles should be paid attention to in the urban landscape aesthetic value planning to pursue the unique aesthetic and create aesthetic taste.

4.1 Nurturing Natural Passion

Nature is scientific and rational. People are an important part of the natural ecosystem. The various parts of the natural system are interrelated and inseparable. The destiny of mankind is closely related to the fate of other lives in the ecosystem. Therefore, human beings should respect and protect nature. Only by respecting nature can we have nature. In the process of exploring the urban landscape, if the ecological environment is unscrupulously destroyed, the ultimate harm is not only nature, but also human beings. In addition, the premise of eco-tourism advocated now is to protect and respect nature. However, it is even more crucial to "maintain the lives of local people", develop the local economy, and improve the standard of living.[3] Therefore, in the construction of urban environmental landscape, people are encouraged to travel in a civilized way. The city itself must also be linked to the natural landscape and the human landscape, use and protect the urban landscape, and develop the urban landscape according to local conditions.

4.2 Combining the Charm of History and Culture

History is a testimony to the process of urban development, and culture is the soul of a city. The construction of modern cities should be a spiritual product that can reflect the innovative spirit of the times and the historical and cultural heritage. It is the aesthetic value. When a country respects its own history, the study of national history and culture, and its scholars, this country and nation must be respectable. On the contrary, if a country or a nation does not respect its history and culture, its research and scholars and knowledge, it will not be respected.[4] The same is

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true of urban culture. Urban culture is a high-level manifestation of human culture. The great human culture is basically produced in the city, so the history of the world is reflected in the history of human cities. The city is a typical representative of the study of regional culture. For example, in China, the representative of Beijing-style culture is Beijing, the representative of Shanghai-style culture is Shanghai, and the representative of Lingnan culture is Guangzhou. These illustrate the connection between urban and regional culture. Therefore, it can be seen that the urban environment landscape is inseparable from the mosaic of history and culture. The construction of urban environmental landscape should combine the historical text and the charm of historical culture to provide residents with a sense of belonging and identity.

4.3 Integrating the Aesthetic with People-Oriented

The human-centered idea is paid attention to and integrated with aesthetics, because human beings are the main body of urban construction and the founder of the whole city. The construction of urban landscape is inseparable from human factors. Therefore, the city landscape must pay attention to the humanized design. This can improve the cultural level of the whole city. In the design of urban landscape, the needs of residents should be considered. This includes two aspects. One is to meet the basic living needs of residents, that is, physical and psychological needs, reflecting the functions of the city. Another is the need of residents to pursue beauty. Aesthetic elements that are pleasing to the eyes of the residents are integrated. In the urban environmental landscape aesthetic value planning, we should first realize the functional role of the city, and then carry on the aesthetic construction. The functionality and aesthetics of the city are combined to serve the residents and pay attention to the people-oriented thought.[5]

5. Aesthetic Value of Planning Urban Environment Orientation

The most basic theory of urban landscape planning is to meet the needs of people in urban life and the needs of spiritual aesthetics. Protection, utilization, improvement and development of urban landscape are various landscape elements. This theory provides the case for urban development from the whole to the individual. Overall policy requirements from the near term to the long term are introduced. It also reflects, controls and guides the urban material construction trend and promotes the formation of a good urban landscape system. Therefore, the urban environment design orientation is scientific and reasonable, which can not only meet the basic physiological needs of the residents, but also meet the psychological needs of the residents to pursue beauty. However, in the construction and creation of urban landscape, due to the different characteristics and preferences of designers, the design orientation of urban landscape is also different. Although different people have different views on the same landscape, every wonderful landscape has its own characteristics of beauty. Therefore, the idea of beauty should be introduced into urban landscape planning. It is necessary to have high and strict requirements on urban design. Space and time are combined with aesthetic factors to meet people's aesthetic requirements. Like works of art, urban landscapes are three-dimensional structures that are expressed in concrete and abstract art forms. However, urban design is also different from other works of art. Urban landscape design has two functions: practicality and aesthetics. People are the creators of cities. The construction and development of cities should be people-oriented, so that people and cities can develop in harmony. Therefore, in the design of urban landscape construction, the elements of beauty are integrated.[6]

5.1 The Fusion of the Connotation of Traditional Culture and the Passion of Modernization

Traditional culture is closely related to the life of the residents and is reflected in the development of urban construction. The construction of the city was promoted along the development of traditional culture. The lifestyle of the residents will also be affected by various other cultures, so the urban landscape construction is urgently required to be transformed. Urban landscape should not only focus on the construction of function and aesthetics, but also let people actively integrate into the urban landscape. Foreign culture and emerging culture have changed people's way of life, as well as the traditional way of life under traditional culture. People's lives are changing quietly. Residents have diversified their outdoor activities and moved from indoor to public places to actively participate in group activities. The way of life is moving from the individual to the collective. Therefore, the traditional cultural connotation and modern passion are merged. Modern urban landscape aesthetics should pay attention to the construction of collective activity space according to people's living style, so as to provide convenience for people's collective activities.

5.2 Adaptation to Local Condition

A good urban landscape affects people's living conditions and personal development. A healthy and good living environment is conducive to the construction and development of the city. Therefore, urban construction must pay

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attention to the strategy of adapting measures to local conditions. Unique urban landscapes are designed according to local characteristics. Natural and man-made landscapes are combined. In this way, the harmonious development between man and nature and between man and city is realized. For example, Italy's Venice has many rivers, large water areas, and various rivers interlaced, which initially brought great inconvenience to people's travel. However, Venice uses the development strategy tailored to local conditions to give full play to the advantages of water transport and replace the roads with water. The water canal road, such as the chessboard, not only facilitates people's travel, but also makes water transport a major attraction and feature, which makes Venice the world-famous water city. The strategy of adapting to local conditions not only helped Venice to accept the restrictions brought by the inconvenience of transportation and facilitated the residents, but also promoted the development of the tourism industry in Venice. This strategy can be said to achieve many things at one stroke.[7]

City-building and location-specific strategies are not immediately achievable, and the distinction between them is blurry. Therefore, the construction of urban environmental landscape should combine the characteristics of its own city, combine traditional culture with the culture of the times to create a suitable model for the development of the city itself, and form its own unique urban characteristics. In urban planning, various factors should be considered comprehensively. Details are taken into account in urban planning. The development status and future prospects of the city itself are considered to select the most suitable construction mode and complete the construction according to local conditions. From the results of urban landscape construction development, only the construction and development in accordance with local conditions can promote the construction and development of the city. This promotes the development of urban economy so that residents can enjoy the beauty of urban landscape.

5.3 Intersection of Time and Space

Space is the main body of a city, and the change of urban space will affect the change of urban appearance. People can enhance the understanding of the city by crossing different urban spaces to obtain the appearance and impression of the city. This is the reflection of people's space modeling. Therefore, the principle of convergence of time and space and integration of beauty should be upheld. Architectural style is inextricably linked to time, as space changes over time. The time factor is embedded into the form, which will enhance people's enjoyment of urban landscape and make residents devote themselves to the urban landscape.[8]

6. Conclusion

To sum up, urban landscape design and planning at the present stage is not only a systematic and scientific behavior, but also the main channel to reflect urban culture. The urbanization process is accelerating in China, and cities are vigorously carrying out urban construction. In this era of pursuing speed and efficiency, the aesthetic work of urban environmental landscape is of great urgency. In urban construction, the planning and guiding analysis of landscape aesthetic value should be emphasized. We should be good at discovering and using beauty to complete urban construction and build a better city life. Therefore, based on environmental landscape aesthetics and the visual experience of urban residents, urban landscape designers conduct artistic treatment of urban environment, solve the conflict between landscape objects and nature in urban construction, and create an atmosphere with strong aesthetic value for urban residents' life.

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REVIEW

Analysis of Effective Optimization Methods for Building Construction Technology Management

Zongbing Lu*

Nantong Xinhua Construction Group Co., Ltd., Nantong, Jiangsu, 226333, China

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ABSTRACT

During the construction process of the construction project, the construction technology management work can improve the overall quality of the project construction. In the context of increasingly fierce competition in the construction market, construction enterprises should strengthen the management of construction technology, enhance their technical level and market competitiveness, and promote the development of the construction market[1]. The paper mainly analyzes the optimization methods of building construction technology management.

1. Introduction

In the rapid development of social economy, China's construction industry is developing very rapidly, the scale of construction engineering is expanding, and people are paying more and more attention to construction technology problems. The management level of construction engineering is closely related to the overall quality of engineering construction. Relevant departments need to analyze the construction site management methods and optimization measures in depth, and improve the construction quality of construction projects[1]. Based on this, the article expounds the basic contents of building construction technology management, introduces the importance of building construction technology management optimization, analyzes the problems existing in building construction technology management, and summarizes the corresponding optimization measures.

2. Basic Contents of Building Construction Technology Management

In the rapid development of social economy, there are more and more types of buildings in China, the structure of buildings is more complicated, and the planning of construction projects is more and more novel, which largely meets the work and life needs of people. At this stage, China has increased capital investment in infrastructure construction. The construction industry has gradually developed into one of the pillar industries for social and economic development. It plays an important role in the development of the national economy and is a key component in the development of modern society. In the development of modern society, the Chinese construction market is increasingly chaotic, the market competition in the construction industry

**Corresponding Author:*
Zongbing Lu,
Nantong Xinhua Construction Group Co., Ltd., No. 34 Xinjin Road, Tongzhou District, Nantong, Jiangsu, 226333, China;
E-mail:13910936665@126.com.

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is becoming fiercer, and construction enterprises should do a good job in construction technology management, so as to improve the overall quality of engineering construction and create more economic benefits[2]. At the same time, construction enterprises also need to introduce more advanced construction techniques and management methods, increase the training of talents, improve the problems in the operation of construction enterprises, and enhance the market competitiveness of enterprises. The construction of construction projects is characterized by complexity, there will be investment in construction costs in each construction link, and the links between the various construction links are very close. Enterprises should strengthen the management of the whole process of construction, avoid unnecessary economic losses, and establish a good corporate image. At the same time, in the construction process of construction projects, construction enterprises should strengthen the management of construction engineering construction technology, introduce more advanced technologies, and establish a sound management system to support the overall quality and safety of construction projects.

3. The Importance of Effective Optimization of Building Construction Technology Management

3.1 Improve the Construction Quality of Construction Projects

In the project construction process of the construction projects, in order to improve the quality of the project construction, relevant departments need to introduce advanced construction technology. Construction engineering is technically intensive, which requires the introduction of more excellent construction techniques as support. In the process of building material selection, construction technology and construction technology application, enterprises need to arrange professional management personnel to guide the construction project to ensure the effectiveness of construction projects and improve the overall quality of construction projects. Therefore, in the construction process of construction projects, construction enterprises must introduce advanced construction techniques, in order to create more high-quality projects and provide technical support for the effective implementation of project construction.

3.2 Effectively Control Building Construction Costs

Construction projects are relatively large in scale, and a large amount of capital is required in the actual construction process. Therefore, in the construction process of construction projects, in order to create more benefits, relevant departments need to strengthen the control of construction costs, and introduce more advanced and scientific construction technology, reasonably select and plan construction materials, construction process, minimize the cost of all aspects of construction, and obtain more benefits[3]. In addition, the effective implementation of construction engineering construction technology management can reduce the problem of resource waste, achieve the expected construction effect, and realize the full utilization of human, material and financial resources, which creates more economic benefits for construction enterprises and enhances the comprehensive competitiveness of construction enterprises.

4. Existing Problems in Building Construction Technology Management

At this stage, in the construction process of China, the level of construction technology management needs to be improved, and there are still a series of problems that need to be addressed, which requires relevant management personnel to thoroughly analyze the construction technology management issues summarized in the construction process. In this way, the construction enterprise can formulate corresponding solutions to improve the management level of construction technology. At present, the problems in the construction technology management are mainly reflected in the following aspects.

4.1 Construction Technology Management System Needs to Be Perfected

The perfection of the construction technology management system directly affects the overall effect of construction technology management. However, in the development of modern society, the construction technology management system of Chinese construction enterprises is still not perfect, which makes the construction enterprises lack information exchange and communication, material management work is not in place, and construction resource management is not enough. At present, the inadequate construction technology management system has become a key issue in the development of construction enterprises. Relevant departments need to take reasonable measures to effectively improve the construction technology management level of enterprises and create more benefits for construction enterprises.

4.2 There Are Defects in the Theory of Building Construction Technology System

In the rapid development of society, many construction

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enterprises have begun to recognize the importance of the construction technology system, however, affected by the factors such as the technology, scale and total amount of construction enterprises, only large-scale enterprises can formulate construction technology solutions, while small-scale construction enterprises still have certain gaps in the process of implementing construction technology management system, which has brought many technical problems for the construction of construction projects. For example, the allocation of human resources management is relatively confusing, the technical talents are insufficient, the work of the posts and the staff are out of line, and the construction enterprises have not subdivided the various technical departments and cannot be improved according to the rules and regulations, which makes many positions unable to make up for technical vacancies[4]. In addition, the relevant departments have not been managed in accordance with relevant rules and regulations. In the process of personnel management and guidance, the overall quality and safety awareness of the staff are relatively weak, and there is a lack of attention to relevant systems, in the actual construction process, the employees did not follow the relevant procedures, and often operated in their own way, which adversely affected the overall quality of construction projects.

4.3 Construction Site Supervision Is Not in Place

Construction project management is a labor-intensive job that requires a large amount of labor, making the degree of education of practitioners very different, and it brings certain difficulties to the management and control of operators, which has led to a series of problems at the construction site, such as the construction machinery and equipment, the random placement of materials, the lack of rationality in the operation and planning of the construction site, and the failure to operate in accordance with relevant standards and rules and regulations[5]. Moreover, the combination of construction workers is unreasonable, and there is a lack of strict discipline between various construction workers as a constraint, and the spirit of solidarity and cooperation is lacking, which seriously hinders the effective implementation of construction projects.

4.4 Strengthen the Control of Construction Quality of Construction Projects

There are many construction engineering operation procedures and a wide range of professional knowledge, which brings certain difficulties to the construction control and comprehensive inspection work, such as the phenomenon of quality problems missing during the sampling inspection. Moreover, during the construction of the construction project site, the relevant departments did not comprehensively control the actual construction, such as whether the construction meets the quality standards, the rework and repair losses caused by the unqualified items, and the costs not increased for the prevention and control, which has caused unnecessary cost investment in the project construction.

5. Effective Optimization Methods for Building Construction Technology Management

5.1 Optimization for Management Organization of Building Construction Technology

There are big differences in the levels of general contracting units and subcontracting units in large-scale construction projects, in the process of establishing the construction management technology management organization system, relevant personnel need to pay attention to the differences between the hardware and software equipment of each contractor, and provide guarantee for the rationality of the operation of the construction technology management organization system[6]. At the same time, the general contractor, subcontractors, contractors, etc. can not only manage according to the contract, but also need to integrate the construction technology management organization system into the on-site management process, and in the process of subcontracting, the technical management work needs to be completed and the professionals are responsible. In the whole process of building construction, construction units shall strengthen coordination and cooperation with various units, strengthen the management of on-site personnel, do a good job in personnel reserve, training and management, improve the overall quality and professional level of construction site personnel, and enhance the safety awareness of construction workers.

5.2 Formulate Construction Technology Management System

In the development of the construction industry, relevant departments need to establish a sound construction management system, and implement the various rules and regulations in the system into actual work. Construction enterprises need to establish professional management departments, strengthen the management of the whole process of on-site construction, and achieve the expected goals of the technical management system. In order to achieve the expected goals of construction project construction, construction enterprises need to continuously improve, so as to improve the overall quality of construc-

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tion projects and promote the further development of the construction industry[7]. In the process of construction technology management of construction projects, in order to implement the management system and system into practice, the general subcontracting enterprise management should constrain and manage the contracted enterprise, clarify its own job responsibilities, reasonably arrange the design planners to design the project, and implement the contents of the plan. In the construction process of a construction project, when unreasonable problems are found, it is necessary to adjust in time according to the actual conditions of the project construction to reduce unnecessary cost investment. In addition, after the completion of the project, it is necessary to carry out a final inspection, and the project is completed after meeting the relevant national technical standards.

5.3 Strengthen the Management of Construction Technology Implementation

In the whole process of construction, the construction enterprise needs to clarify the duties and responsibilities of the management personnel of each construction link, and implement all the work to individuals and departments, and strictly require the construction personnel to carry out construction according to the construction standards and relevant specifications. It is strictly forbidden to operate in violation of regulations, and in case of violations, it needs to be resolved in a timely manner. In addition, the construction enterprises need to strengthen the emphasis on the construction progress of the construction project, rationally allocate the construction resources according to the various influencing factors in the construction process, provide support for the effective implementation of the construction of the project, and complete the construction operations on time according to the specified construction period, so as to continuously improve the construction quality of construction projects and create more benefits for construction enterprises[8].

6. Conclusion

In summary, in the rapid development of social economy, the scale of construction of China's construction projects is constantly expanding, and all levels of society put forward more stringent requirements on the construction quality of construction projects, which makes the importance of building construction technology increasingly prominent[5]. However, at this stage, there are still a series of problems in the construction technology management, which affects the construction quality of the construction project, which requires the construction units to take corresponding optimization measures to optimize the construction technology management methods.

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